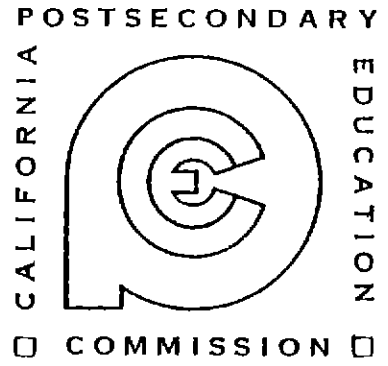
PART-TIME AND FULL-TIME ENGINEERING FACULTY IN THE UNIVERSITY OF CALIFORNIA AND THE CALIFORNIA STATE UNIVERSITY



CALIFORNIA POSTSECONDARY EDUCATION COMMISSION

PART-TIME AND FULL-TIME ENGINEERING FACULTY IN THE UNIVERSITY OF CALIFORNIA AND THE CALIFORNIA STATE UNIVERSITY

A Report to the Legislature in Response
To Senate Resolution 37

CALIFORNIA POSTSECONDARY EDUCATION COMMISSION
1020 Twelfth Street, Sacramento, California 95814

Commission Report 84-37

Adopted December 10, 1984

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TABLES

INTRODUCTION

Senate Resolution No. 37 (1983-84, attached) requests the Commission, in conjunction with the University of California and the California State University, to report by December 13, 1984, (1) their existing ratio of full-time to part-time faculty for undergraduate engineering programs, (2) the minimum full-time staffing requirements as a function of undergraduate student enrollments in the schools of engineering on each campus, (3) the relation of these ratios to standards of the appropriate professional accrediting body, and (4) the budget requirements needed to fund an appropriate full-time undergraduate faculty at all University and State University schools of engineering.

Subsequent to adoption of the resolution, its author, Senator Leroy Greene, asked the Director of the Commission that the report cover more than undergraduate programs and faculty:

> The [faculty shortage] problem does not divide itself according to undergraduate degree faculty and graduate degree faculty, since the same faculty persons are teaching at all levels. The resolution inadvertently speaks of "undergraduate" students and programs, however, the problem is not related to the levels. Therefore, the study should consider the faculty situation in total and not just the undergraduate level. The original form of the resolution covered this appropriately The data from the study would have little or marginal value if it were limited to the undergraduate situation -- particularly in the California State University.

In August 1984 Commission staff requested the necessary statistical data for all instruction in engineering from the University of California and the California State University for the 1983-84 academic year. Staff also requested and obtained copies of the criteria for accrediting engineering programs from the Accreditation Board for Engineering and Technology (ABET), the professional accrediting body for engineering programs. David R. Reyes-Guerra, executive director of ABET, kindly supplied copies of the criteria that will be applicable to all programs during the 1984-85 academic year and that incorporate all changes approved by the ABET Board of Directors as of October 14, 1983, plus copies of proposed revisions in these criteria that, if approved, will become effective for program evaluations during 1985-86. He also provided clarifying statements on ABET policy and opinions on (1) ratios of faculty to students and (2) part-time faculty and its role.

Officials of the University of California and the California State University submitted the requested data on their programs and faculty. These data from the University and comparable institutions are presented in Chapter One, while those for the State University and comparable institutions appear in Chapter Two; national indicators of the use of part-time faculty are summarized in Chapter Three; the relationship of these data to ABET accreditation criteria are presented in Chapter Four; and a brief overview of the findings of this study will be found in Chapter Five.

Because most sources of information on part-time faculty report the ratio of part-time to total faculty rather than of part-time to full-time faculty, unless the ratios presented in this report are identified otherwise, they relate to total faculty.

ONE

ENGINEERING FACULTY OF THE UNIVERSITY OF CALIFORNIA

Six campuses of the University of California offer engineering programs. Table 1 below displays the headcount number and employment status of faculty in these programs at each of these six campuses.

Table 1 shows that 39.5 percent of the approximately 1,000 engineering faculty at the University are employed part time, with the campuses ranging from 16 0 percent in chemical engineering at Berkeley to 70.1 percent in engineering at Irvine. The Irvine campus employs over twice as many part-time faculty as full-time faculty in engineering. No other University campus employs more part-time than full-time engineering faculty, although the Los Angeles campus comes close (49.3 percent).

TABLE 1 Number of Part-Time and Full-Time Faculty in Engineering at the University of California, 1983-84

Campus	Part Time	Full Time	Total Faculty	Percent Part Time
Berkeley				
Engineering	70	215	285	24.6%
Chemical	4	21	25	16.0
Davis	47	80	127	37.0
Irvine	68	29	97	70.1
Los Angeles	137	141	278	49.3
San Diego	30	61	91	33.0
Santa Barbara	40	60	100	40.0
Total	396	607	1,003	39.5%

Note: Chemical Engineering at Berkeley is offered in the College of Chemistry rather than the College of Engineering. In order for this report to be all inclusive on engineering programs, it is included in this report but as a separate entry. The College of Chemistry offers programs leading to the B.S., M.S., and Ph.D. degrees in chemistry and in chemical engineering, and its curriculum leading to the B.S. degree in chemical engineering is accredited by the Accreditation Board for Engineering and Technology (ABET)

Source. Office of the President, University of California, and Commission staff analysis.

FULL-TIME EQUIVALENT FACULTY

While the literature on part-time faculty tends to report percentages of part-time faculty in terms of headcount numbers, a more meaningful percentage involves full-time equivalent faculty. Table 2 presents data in these terms for instructional faculty at the University.

Tables 1 and 2 cannot be interrelated because full-time faculty do not necessarily devote their full time to instruction and because part-time faculty carry variable portions of the instructional load. Nevertheless, Table 2 should dispel some erroneous conclusions that could be derived from Table 1. For example, part-time faculty are not responsible for 70 percent of the course work at Irvine. As Table 2 demonstrates, slightly less than one-fifth of the instructional full-time equivalent faculty is comprised of part time faculty members. This figure still represents a higher portion of the instructional load carried by part-time faculty than on other University of California campuses or, based on sources described later in this report, most other comparable institutions, which devote between 5 and 10 percent of these full-time equivalent positions to part-time faculty All campuses of the University except for Berkeley, in fact, appear to depend more heavily on part-time faculty than their comparable institutions (Table 3). Their overdependence stems from their lack of competitive faculty salaries during the early 1980s. The 1984-85 faculty salary increases approved by the Legislature and the Governor will improve dramatically the University's ability to recruit and retain quality faculty in the future, assuming the University's competitive position will be retained, although these increases came too late to have significant impact on recruitment for Fall 1984.

TABLE 2 Full-Time Equivalent (FTE) Instructional Faculty in Engineering at the University of California, 1983-84

Campus	Part Time	Full Time	Total FTE Instruction	Percent of Total Represented by Part-Time Faculty
Berkeley				
Engineering	22.54	179.95	202.49	11.1%
Chemical Engineering	1.50	20.25	21 75	6 9
Davis	14.00	80.00	94.00	14 9
Irvine	7.00	29.00	36.00	19 4
Los Angeles	28.61	139.92	168.53	17.0
San Diego	11.40	61.00	72.40	15 7
Santa Barbara	10.27	53.33	63.60	16.1
Total	95.32	563.45	658.77	14.5%

Source: Office of the President, University of California, and Commission staff analysis

IMPACT OF UNFILLED FACULTY POSITIONS

The number of vacant full-time budgeted engineering faculty positions on each campus appear in Table 3. If qualified candidates for these positions can be found and hired, the University will add 59 5 full-time faculty -- an increase of approximately 10 percent over existing levels -- and the number of part-time faculty will be reduced by approximately two-thirds This

TABLE 3 Vacant Engineering Faculty Positions at the University of California and the Estimated Effect on Its Faculty Composition of Filling These Positions, Compared with the 1983 Faculty Composition of Comparable Doctorate-Granting Universities

Campus or Institution	Number of Unfilled Positions	Projected Percentage of Part-Time Faculty	
		Headcount	Full-Time Equivalent
Berkeley			
Engineering	9	14.3%	5 9%
Chemical Engineering	1	16 7	6.7
Davis	14	20.0	4.8
Irvine	5	12.5	5.6
Los Angeles	15	25.0	10.0
San Diego	6	16.7	9.1
Santa Barbara	9.5	18.7	5.7
Total	59.5		
Average		17.1	6.8
Massachusetts Institute of Technology		9.2%	4.9%
University of Illinois		7.6	2.6
University of Michigan		17.9	11.4
Ohio State University		20.9	7.4
University of Washington		13.5	2.5
University of Texas		17.7	8.0
University of Minnesota		20.9	6.6
Rensselaer Polytechnic Institute		7.2	9 8
Carnegie-Mellon University		22.0	11 6
University of Wisconsin-Madison		16.3	9.6
Columbia University		23.1	10 3
State University of New York, Buffalo		18.9	9 5
Princeton University		5.1	1 0
Average		15.4	7.7

Sources: Office of the President, University of California; National Science Foundation, 1983, Table B-41, Commission staff analysis.

would leave the equivalent of approximately 35.8 full-time positions to be filled by approximately 149 part-time faculty if campus instructional loads remain stable. Commission staff estimates of the change that would occur in the percentage of part-time to total headcount faculty and the percentage of total instructional full-time equivalent faculty represented by these part-time faculty members if all full-time budgeted positions were filled also appear in Table 3

Finally, Table 3 displays data derived from the National Science Foundation's latest report on academic science and engineering from comparable doctorate-granting universities. Filling these vacant budgeted full-time positions would bring the University more nearly in line with the head count and full-time equivalent percentage of part-time faculty at these institutions.

FACULTY-STUDENT RATIOS

The faculty-student ratios in engineering in the University listed in Table 4 are in accord with the ratios suggested by the Accreditation Board for Engineering and Technology. Comments on these ratios appear in Chapter Four.

TABLE 4 Faculty-Undergraduate Student Ratios in Engineering in the University of California, 1983-84

Campus	Budgeted Ratio: Faculty to Undergraduate Students
Berkeley	
Engineering	1:12
Chemical Engineering	1:12
Davis	1:13
Irvine	not reported
Los Angeles	1:13
San Diego	1:13.5
Santa Barbara	1·14

Source: Office of the President, University of California.

TWO

ENGINEERING FACULTY OF THE CALIFORNIA STATE UNIVERSITY

Thirteen of the 19 State University campuses offer engineering programs. Data supplied by the Office of the Chancellor and reported in Table 5 below indicate that most of these campuses depend heavily on part-time engineering faculty.

Table 5 shows that nearly one-half of the 1,316 engineering faculty in the State University are employed on a part-time basis, with one campus (San Jose) employing over 65 percent on a part-time basis. Five other campuses -- Fullerton, Long Beach, Los Angeles, Northridge, and San Francisco -- have between 56 and 59 percent part-time faculty, while three others -- Pomona, Sacramento, and San Diego -- have between 46 to 49 percent. Only three of all 13 -- Chico, Humboldt, and San Luis Obispo -- employ less than one-fourth of their engineering faculty part time.

TABLE 5 Number of Part-Time and Full-Time Instructional Faculty in Engineering at the California State University, 1983-84

Campus	Part Time	Full Time	Faculty	Percent Part Time
Chico	6.0	23.5	29.5	20 3%
Fresno	15.0	31.5	46.5	32 3
Fullerton	49.0	35.5	84.5	58.0
Humboldt	1.7	10.0	11 7	14.5
Long Beach	92.5	63.5	156.0	59.3
Los Angeles	42 0	28.8	70.8	59 3
Northridge	63.3	48.0	111.2	56.9
Pomona	103.4	107.3	210.7	49 1
Sacramento	50 0	56.0	106.0	47.2
San Diego	45.2	52.8	98.0	46.1
San Francisco	20.8	15.0	35.8	58.1
San Jose	125.0	66 3	191.3	65.3
San Luis Obispo	36.7	127 7	164.3	22.3
Total	650.4	665.9	1316.3	49.4%

Note: Fractional assignments result from individuals having joint appointments or teaching-administrative assignments

Source: Office of the Chancellor, The California State University, and Commission staff analysis.

FULL-TIME EQUIVALENT FACULTY

Converting the workload of full-time and part-time faculty to full-time equivalent instructional faculty reveals information about the portion of the instructional load that is carried by part-time faculty members. These converted figures for the State University's campuses appear in Table 6

Table 6 reveals that four campuses -- Long Beach, Los Angeles, San Francisco, and San Jose -- assign over 30 percent of their engineering instruction to part-time faculty, and that five others -- Fullerton, Northridge, Pomona, Sacramento, and San Diego -- assign between 20 to 30 percent to such faculty. These nine campuses offer many more courses via part-time faculty than does any University campus -- even Irvine, which leads the University campuses with 19.4 percent. Overall, the 13 State University campuses offer 22.0 percent of their engineering instruction by part-time faculty, compared to 14.5 percent at the six University campuses.

TABLE 6 Full-Time Equivalent Instructional Faculty in Engineering at the California State University, 1983-84

Campus	Part Time	Full Time	Total FTE Faculty	Percent of Total Represented by Part-Time Faculty
Chico	2.0	22.3	24.3	8.2%
Fresno	5 6	30 4	36.0	15 6
Fullerton	11.8	33.7	45.5	25.9
Humboldt	0.6	9.3	9.9	6 1
Long Beach	25.9	59.7	85.6	30.3
Los Angeles	12 4	27 7	40 1	30.9
Northridge	13 7	43.5	57 3	23.9
Pomona	30.3	101.7	132.0	23 0
Sacramento	13.9	51.5	65.3	21.3
San Diego	12.0	47.9	59.9	20.0
San Francisco	6.7	14.2	20.9	32 1
San Jose	30.6	61.8	92.4	33.1
San Luis Obispo	11.1	121.6	132.6	8 4
Total	176 5	625.5	802.0	22.0%

Source: Office of the Chancellor, The California State University, and Commission staff analysis.

IMPACT OF UNFILLED FACULTY POSITIONS

According to information provided by State University officials, if engineering faculty salaries in the State University were more competitive and if qualified candidates for faculty positions could be found, the State University would add, at a minimum, the equivalent of approximately 68 full-time faculty. These additional faculty members would be distributed among its campuses as shown in Table 7. Table 7 also displays the percentage of part-time to total faculty by headcount and full-time equivalent faculty that would result from this addition as well as the 1983 percentages at some institutions used by the State University for purposes of salary comparisons.

TABLE 7 Estimated Vacant Engineering Faculty Positions at the California State University and the Estimated Effect on Its Faculty Composition of Filling These Positions, Compared with the 1983 Faculty Composition of Some of Its Salary Comparison Institutions

Campus or Institution	Estimated Number of Unfilled Positions	Projected Percentage of Part-Time Faculty	
		Headcount	Full-Time Equivalent
Chico	0	20 3%	10.0%
Fresno	2	13.4	10 0
Fullerton	2.7	23.2	20.0
Humboldt	0.1	13.6	4.7
Long Beach	4.5	22.9	25.0
Los Angeles	8.75	13.1	9.1
Northridge	4.25	20.7	16.7
Pomona	18.3	8.7	9.1
Sacramento	4.5	16.9	14.3
San Diego	--	--	20.0
San Francisco	3.22	22.2	16.7
San Jose	16 75	17.7	15 0
San Luis Obispo	3.0	12 4	6.0
Total	68.07 (estimated)		
Average		17.0	13 6
Iowa State University		6 7%	3 7%
Virginia Polytechnic Institute		1.3	1.0
University of Colorado		6.5	3.3
University of Southern California		13 9	3 7
Syracuse University		38.3	10 3
Oregon State University		8 6	2.3
University of Wisconsin-Milwaukee		44 8	29.7
Southern Illinois University		6.5	1 9
Wayne State University		37 3	17 9
Average		18.2	8.2

Source Office of the Chancellor, The California State University; National Science Foundation, 1983, Table B-41; Commission staff analysis.

Addition of these 68 full-time engineering faculty members would reduce the number of part-time faculty members from 650 to approximately 236, which State University officials believe is an adequate number to bring special expertise to its programs. These 68 vacant positions should not be considered as representative of the State University's total need for qualified full-time engineering faculty in 1984-85, however, for at least four reasons:

1. Some campuses have allocated additional positions to engineering from other fields in an effort to accommodate student demand
2. Campuses have been conservative in position allocations because of equipment and facility limitations.
3. Position allocations have been conservative because of the lack of success in past recruitment efforts for engineering faculty.
4. Some campuses are employing many full-time temporary faculty who are not eligible for tenure-track appointments, and to replace them by more highly qualified faculty would increase the need to recruit additional faculty.

By 1985-86, the number of the State University's vacant full-time tenure-track faculty positions in engineering is likely to exceed 100.

FACULTY-STUDENT RATIOS

Both the headcount faculty-student ratios and full-time equivalent faculty-student ratios in engineering at the State University are somewhat high on a few campuses, as Table 8 below indicates and as Chapter Four later notes.

TABLE 8 Faculty-Student Ratios in Engineering in the California State University, 1983-84

Campus	Headcount Faculty-Student Ratio	Full-Time Equivalent Faculty-Student Ratio
Chico	1.27	1 16
Fresno	1:22	1·15
Fullerton	1:20	1 17
Humboldt	1:23	1·14
Long Beach	1.26	1.20
Los Angeles	1:23	1:16
Northridge	1:16	1·14
Pomona	1.19	1.15
Sacramento	1.18	1:15
San Diego	1:28	1·20
San Francisco	1.22	1·14
San Jose	1:15	1:15
San Luis Obispo	1:22	1:16
Average	1·21	1:16

Source: Office of the Chancellor, the California State University

THREE

NATIONAL DATA ON PART-TIME FACULTY

Little information exists either nationally or in California on the ratio of full-time to part-time faculty by discipline, but the following paragraphs summarize the major sources of information that do exist.

NATIONAL CENTER FOR EDUCATION STATISTICS

The National Center for Education Statistics conducts most of the major surveys in postsecondary education, but its data on employment of part-time and full-time faculty cover campuses as a whole and thus obviate any possible comparisons by discipline. Data compiled by the Center indicate that as of 1980, part-time faculty comprised 32 percent of the total teaching force in higher education. Approximately 20 percent of the teaching staff at research universities were employed part-time, as were 24 percent at four-year liberal arts colleges and 51 percent at community colleges (American Association of University Professors, 1981).

NATIONAL SCIENCE FOUNDATION

The National Science Foundation conducts an annual survey of science and engineering employment in academia. Its 1983 survey found that 358,800 academic science and engineering professionals were employed either full time or part time in 1983, a 3-percent increase over 1982 levels. Full-time employment gains held steady at 2 percent, similar to findings during the 1973-1982 period, while part-time employment was up 5 percent. As a result, in 1983, part-time faculty increased their share of the total to 24 percent, compared to 18 percent a decade earlier in 1973. This trend toward expanded use of part-time professionals occurred across almost all science and engineering fields in all types of institutions, but mostly at two-year colleges. The summary for engineering in Table 9 has been derived from various tables in the Foundation's report. As Table 9 indicates, as of January 1983 part-time faculty constituted 15 8 percent of the total engineering faculty in the nation's doctorate-granting institutions, 31.2 percent in comprehensive institutions, and 44.4 percent in the community colleges.

TABLE 9 Engineers Employed in the Nation's Universities and Colleges, January 1983

Faculty Status	Type of Institutional Category: Doctorate Granting	Comprehensive	General Baccalaureate	Professional and Specialized	Two-Year
Total	20,597	6,300	950	3,519	6,330
Full Time	17,349	4,337	719	2,894	3,517
Part Time	3,248	1,963	231	625	2,813
Percent Part Time	15.8%	31.2%	24.3%	17.8%	44.4%
Ratio of Part Time to Total	1 6.3	1:3.2	1:4.1	1:5.6	1:2.3

Source: Adapted from National Science Foundation, 1983, Tables B-76, B-77, and B-85.

While this summary is relevant to this report, it nevertheless must be approached with caution. For example, its numbers include those engineering employees at colleges and universities who devote all or part of their activities to research and development rather than instruction, and they apply to total faculty in engineering, not just to undergraduate instructors.

Table 10 examines these relationships by geographic region As can be seen, the percentage of total engineers in colleges and universities who

TABLE 10 Engineers Employed in the Nation's Universities and Colleges by Geographic Region, January 1983

	Faculty Status: Total	Full Time	Part Time	% Part Time
New England	3,313	2,638	675	20 4%
Middle Atlantic	6,470	4,618	1,852	28 6
East North Central	6,583	5,060	1,523	23.1
West North Central	2,251	1,949	302	13 4
South Atlantic	6,287	5,086	1,201	19.1
East South Central	1,768	1,447	321	18.2
West South Central	2,928	2,356	572	19.5
Mountain	2,605	2,209	396	15 2
Pacific	5,245	3,271	1,974	37 6
Outlying Areas	246	182	64	26 0
Total	37,696	28,816	8,880	23.6
California	4,149	2,491	1,658	40.0%

Source: Adapted from National Science Foundation, 1983, Tables B-60, B-61, and B-62

are employed part time varies widely by geographic region. The West North Central region, comprised of Iowa, Kansas, Minnesota, Missouri, Nebraska, and North and South Dakota, has the lowest percentage of part-time engineers (13 4), probably because of the lack of industry from which quality part-time faculty can be obtained. The Pacific region, including California, has the highest percentage (37.6), with California accounting for nearly 80 percent of the engineering faculty in the region. California's institutions of higher education employed more part-time engineers than any other, and their percentage of these part-time faculty (40.0) was far higher than the national average of 23.6 percent

The National Science Foundation reports also provides data that can be analyzed in terms of full-time equivalent engineering faculty at doctorate and master's-degree granting universities and colleges, as Table 11 illustrates. This table shows that as of January 1983, in both doctorate granting and master's-degree granting colleges and universities, three part-time faculty members in engineering represented the approximate equivalent of one full-time member. In general, master's-degree granting institutions employed nearly twice the percentage of part-time faculty as did doctorate granting universities -- 37.7 percent versus 16.5 -- and only 3 percent of their full-time equivalent faculty were devoted entirely to research and development activities, compared to 30 percent in doctorate granting institutions

TABLE 11 Full-Time Equivalent Engineering Faculty at Doctorate and Master's-Degree Granting Universities and Colleges, January 1983

Faculty Status	Doctorate Granting Universities	Master's-Degree Granting Institutions
Total Faculty	26,167	3,440
Full-Time Faculty	21,849	2,144
Part-Time Faculty	4,318	1,296
Percent Part-Time Faculty	16.5%	37 7%
Total Full-Time Equivalent Faculty	23,290	2,555
Part-Time Proportion of Full-Time Equivalent Faculty	1,441	411
Full-Time Equivalent Faculty Devoted to Research and Development	6,938	79
Percent of Total Full-Time Equivalent Faculty Devoted to Research and Development	29.8%	3.1%

Source: Adapted from National Science Foundation, 1983, Tables AIC and AIG.

UNITED STATES OFFICE OF EDUCATION

In 1967, the U.S. Office of Education issued a report on part-time faculty because of concern as to whether or not the nation's graduate schools could produce enough doctorates and new faculty to satisfy burgeoning enrollment growth. While the report is 20 years old, the conditions at that time in all disciplines bear a remarkable similarity to those in engineering, business administration, and accounting today. The report concluded (p.7):

> The present study, it is believed, provides the most definitive, and the only presently available, data on part-time staffing Their proportion, particularly in some fields, is surprisingly large. Of the total professional staff, 24.3 percent are part-time . . . in academic, 26.6 percent. . . . The high type of the people available for part-time teaching in higher education may justify the institutions in following the practice. At the same time, the institutions should be aware of the heavy administrative load which the full-time staff must bear in order to maintain continuity of programs.

These same concerns about program integrity are reflected in Senate Resolution 37, in statements of the Accreditation Board for Engineering and Technology, and in earlier reports of the Commission devoted to faculty recruitment (1982, 1983a, 1983b).

For example, in its 1984-85 annual faculty salary report, the Commission expressed its concern about overutilization of part-time faculty as follows (p 37):

> Part-time faculty can often bring special expertise to an academic program. In California, the University of California and the California State University have increased their use of part-time faculty in certain disciplines because they have been unable to hire full-time faculty at existing salaries. In addition, business and industry have increased their contributions to universities by loaning them part-time faculty in hard-to-hire disciplines such as engineering and business administration in order to assist and enhance programs in these areas.
>
> Nonetheless, extensive use of part-time faculty raises questions about the adequacy of a "critical mass" of full-time faculty to maintain program integrity. Generally, part-time faculty do not participate in student counseling, curriculum development, institutional governance, and seldom hold office hours or establish times for assisting individual students. Lack of these activities lead to the exploitation of the full-time faculty which contributes to poor morale and adversely affects the quality of education. Over dependence on part-time faculty inevitably injures not only part-time faculty, but their full-time colleagues and, most of all, the students

The Office of Education report draws conclusions about encouraging outstanding students to consider a career in college teaching similar to those found in the Commission's 1983 reports on engineering and business administration (p. 7):

> The magnitude of the task of preparing professional staff for colleges and universities is brought forcibly to attention by the findings of this study. In order to meet the challenge, institutions of higher education must give renewed emphasis to identifying and counseling students who are potential college faculty members, and to support graduate and professional schools. Only by so doing will institutions have the faculties, facilities, and research capabilities necessary to attract students of sufficient quality and in sufficient numbers to meet the needs of the various fields of study.

The USOE study surveyed 1,809 institutions. Data were presented in extreme detail as well as summarized by broad disciplines and all fields for three groupings of institutions: (1) universities, (2) liberal arts colleges, and (3) two-year institutions. Only the proportion of part-time to total faculty are reproduced in Table 12 for the first two of these three groups to illustrate

TABLE 12 Part-Time Faculty as a Percent of Total Faculty in the Nation's Universities and Liberal Arts Colleges, by Discipline, 1963

Discipline	Part-Time Faculty as Percent of Total	
	Universities	Liberal Arts Colleges
Agriculture and Forestry	9.0%	3.8%
Biological Sciences	16.4	14.3
Business and Commerce	34.8	35.8
Education	22 3	20 5
ENGINEERING	19.0	29.0
English and Journalism	18.9	17.8
Fine and Applied Arts	20.4	22.8
Foreign Languages	19.1	18.7
Geography	15.8	18.4
Health Professions	55.2	16.4
Home Economics	14.5	16.2
Law	29.9	61.3
Library Science	26.7	54.3
Mathematical Subjects	26.2	18.2
Philosophy	12 8	20.2
Physical Sciences	15 9	11.8
Psychology	25 1	27 9
Religion	19 4	27 4
Basic Social Sciences	18.7	15.1
Applied Social Sciences	26.5	38.8
All Other	32.0	11.6
Total	27.7%	20.1%

Source: U.S. Office of Education, 1967, p. 46-47 and 62-63.

the variations among broad disciplines. These percentages apply to all faculty in the disciplines, undergraduate and graduate, as do those in the reports described earlier.

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

In its Fall 1983 survey of engineering deans, the American Society for Engineering Education asked about authorized but unfilled faculty positions in engineering (Doigan, 1984) Responses showed an 8.5 percent shortfall nationwide. However, when asked about the number of new faculty required "to maintain or restore quality in your programs," the deans reported that the total number of positions authorized was less than 85 percent of the number needed. Thus the "real" faculty shortage, according to Doigan, is greater than 23 percent nationwide and translates into a need for 22,000 more full-time faculty.

THE CHRONICLE OF HIGHER EDUCATION

In 1983, John Minter Associates, a higher education research organization in Boulder, Colorado, conducted a survey of a national sample of faculty members for The Chronicle of Higher Education. While the survey was directed toward identifying trends, changing attitudes, and overall performance of eight different groups of disciplines from 1980 to 1982, it disclosed some information on problems in recruiting full-time faculty. A summary of responses to three of the 22 questions appears in Table 13.

As can be seen, almost 53 percent of the faculty members in engineering who participated in the survey said their institutions had authorized additional faculty positions for their departments, as did 48 percent in business and economics. In contrast, only 8 and 10 percent of the faculty in physical education and the arts, respectively, reported newly authorized faculty positions, and half of all respondents reported no change in the number of authorized positions.

Over one-third of the engineering faculty members reported that full-time faculty positions in their departments either remained unfilled due to the lack of qualified applicants or had been filled by compromising on qualifications -- the highest promotion of any of the eight fields. The most disheartening finding of the survey was that seven out of ten engineering faculty members did not believe their departments were qualified to carry out their mission -- again, the highest proportion of all eight fields, followed by 62.4 percent in the humanities, 59.6 percent in the sciences, and 59.5 percent in business. Lack of faculty, coupled with decreased support for research assistance, secretarial assistance, travel, leaves of absence, purchase of equipment and supplies, and maintenance of facilities contributed to these views.

TABLE 13 Faculty View of Trends in Their Departments Between 1980 and 1982

	Arts (a)	Humanities (b)	Social sciences (c)	Business (d)	Sciences (e)	Engineering (f)	Vocational education (g)	Physical education (h)	All fields
Number of authorized faculty positions has.									
Increased	9.5%	20.2%	16.9%	47.9%	27.0%	52.8%	26.3%	8.2%	25.8%
Held steady	61.3%	49.9%	60.3%	40.3%	55.8%	36.4%	58.4%	74.8%	50.9%
Decreased	28.8%	29.4%	31.8%	8.1%	17.2%	10.9%	19.8%	17.0%	23.3%
Have you been able to attract qualified staff for full-time positions?									
Yes	45.2%	45.9%	48.1%	36.9%	31.8%	23.8%	33.3%	35.8%	39.4%
Yes, but more difficult	9.9%	18.7%	13.2%	21.9%	15.0%	27.0%	27.8%	8.8%	16.9%
Yes, but compromised on qualifications	5.2%	5.8%	5.0%	16.4%	11.4%	15.1%	6.6%	9.6%	8.6%
No, no qualified applicants	3.0%	6.5%	3.5%	9.2%	9.6%	18.9%	12.7%	4.1%	7.8%
No, unfunded	8.8%	4.1%	5.5%	2.5%	6.9%	5.4%	6.8%	1.2%	5.4%
No opening	24.1%	26.1%	26.3%	11.1%	23.1%	10.2%	8.3%	40.7%	21.9%
Do you feel your department is qualified to carry out its mission?									
Yes	38.2%	34.6%	46.6%	36.2%	28.6%	28.3%	43.1%	46.9%	38.2%
No	57.9%	62.4%	50.8%	58.6%	59.6%	71.0%	54.8%	54.1%	58.6%

Source Watkins, 1983, p. 20.

FOUR

ACCREDITING CRITERIA RELATED TO ENGINEERING FACULTY

Unlike some nationally recognized accrediting agencies for other professions, such as the American Assembly of Collegiate Schools of Business, whose accrediting criteria include many quantitative standards, the Accreditation Board for Engineering and Technology (ABET) has so far relied exclusively on qualitative or non-numerical standards to evaluate engineering faculty and their adequacy in developing professional engineers.*

FACULTY STANDARDS

For example, ABET describes the appropriate size of faculty as follows.

> The proper size of the faculty is determined by the enrollment in the program and by the division of labor in such activities as classroom teaching, laboratory supervision, research, direction of graduate work, extension or continuing education studies, and active participation in professional and technical societies (1983, p 7).

In examining teaching loads, it looks for evidence of concern about improving the effectiveness of pedagogical techniques:

> Teaching loads should be compatible with the existing climate for research and professional development. Engineering faculty members, regardless of their individual capabilities, cannot function effectively either as teachers or seekers of new understanding if they are too heavily burdened with classroom assignments. Stimulation of student minds presupposes constant and energetic faculty study of new developments in areas of technology and science and in areas of instructional innovation (1983 p. 7).

And it assesses faculty qualifications as follows.

> The overall competence of the faculty may be judged by such factors as the level of academic training of its members; the diversity of their backgrounds; their non-academic engineering experience; their

*For a comparison of the standards of ABET and the American Assembly of Collegiate Schools of Business, see pages 39-42 of the Commission's report, Recruitment and Retention of Business Administration and Accounting Faculty, 1983b.

> experience in teaching; their interest in and enthusiasm for developing more effective teaching methods; their level of scholarship as shown by scientific and professional publications; their registration as Professional Engineers; their degree of participation in professional, scientific and other learned societies; recognition by students of their professional acumen; and their personal interest in the students' curricular and extracurricular activities (1983, p. 7).

In other words, ABET does not now specify a particular number or ratio of full-time faculty, limits on teaching loads, or percentages of faculty with the doctorate or other certification. Rather, it stresses that "the heart of any educational program is the faculty," and it expects engineering programs to have competent, qualified, and forward-looking faculty and an overall scholarly atmosphere.

Three revisions in ABET's criteria that relate to faculty size and competence may become effective for evalutions during the 1985-86 academic year, if approved by the ABET Board of Directors. None of these revisions would specify particular part-time/full-time ratios or student-faculty ratios, but they warrant mention here

- The first would add the phrase, "their ability to communicate fluently in English" to the existing statement on faculty competence. This phrase relates to the fact that approximately 40 percent of the engineering doctorates in the United States are awarded to foreign nationals, many of whom gravitate to teaching in American colleges and universities. (American Electronics Association survey of engineering faculty recruitment in the California State University in 1983 disclosed that 51 percent of the engineering faculty hired by the State University during the three prior years were foreign nationals.) While foreign nationals usually have excellent academic credentials, their communication limitations and lack of knowledge about American industry may jeopardize their effectiveness as teachers.

- The second proposed revision would add the following paragraph relative to student advisement:

  > e. The engineering faculty must assume the responsibility of assuring that the students receive proper curricular and career advising. Those individuals responsible for and involved in advising must know and understand the engineering program accreditation criteria, as the criteria reflect the practice of engineering as a profession (1984, p. 8).

- The third proposed revision would expand the criteria on faculty size considerably:

  > b. The faculty must be large enough to cover, by experience and interest, all of the curricular areas of the discipline and to provide technical interaction and stimulation Normally, a program at the basic level must have no fewer than three

> full-time faculty members whose primary commitments are to that program. This statement shall not be interpreted to preclude the accreditation of programs offered primarily by part-time faculty members; however, for such programs the institution must demonstrate that, in addition to the commitment of at least three full-time-equivalent faculty members to the program, effective mechanisms are in place to assure adequate levels of student-faculty interaction, student advising, and faculty concern for and control over the curriculum, as would be expected in programs offered primarily by full-time faculty members. If the faculty has additional obligations, such as graduate teaching and/or research, additional faculty members must be present to ensure that at least three full-time-equivalent faculty members are devoted to each basic-level program. Under no circumstances should a program be critically dependent on one individual (1984, p. 7, underlining added).

If the ABET Board of Directors approves the latter statement for implementation in 1985-86, it will be the first criterion that ABET has adopted that specifies a minimum numerical size of faculty in order to maintain program integrity. (A "program" to ABET means any program for which accreditation is sought.) Thus if a campus were to seek accreditation for civil, electrical, computer, and mechanical engineering -- four programs --under the proposed criterion, it would need at least 12 full-time faculty members -- three for each program -- whose primary commitment is to the programs, and it would have to assure ABET visitors that student counseling, curriculum development, institutional governance, and student-faculty interaction take place at adequate levels.

David R Reyes-Guerra, the executive director of ABET, has amplified on these proposed changes in standards as follows (1984):

> ABET will not prescribe ratios as long as it does not appear to affect quality. We believe that institutions are able to handle this issue without our prescribing any numbers. What may be a good ratio for one program may be extremely poor for another. We rely on our ad hoc visitors to evaluate the total program and base the accreditation decision on the totality of inputs to the program rather than one element itself.
>
> With regard to part-time faculty, we see no reason why they cannot be as effective, as good, and as desirable as full time faculty. Apart from some form of advising and counseling, as well as institutional program committee activity, there does not seem to be any real problem with part-time faculty. One of the essential roles of the full-time faculty is the supervision and control of the curriculum within the prescribed institutional, professional, and accreditation criteria Continuity is provided by full-time faculty. However, the issues of teaching and all its requirements such as effectiveness, appropriateness, state-of-the-art, etc, is not based on whether the faculty is full time or part time.

As a consequence, it appears that ABET's proposed criterion of three full-time equivalent faculty in each program would not impose a hardship on University or State University engineering programs unless the nonclassroom burdens of

counseling, course and program development, and administrative duties place an undue workload on the full-time faculty.

FACULTY-STUDENT RATIOS

Because ABET's guidelines do not specify numerical faculty-student ratios, Commission staff raised the question of headcount ratios with Mr Reyes-Guerra.
He has responded as follows:

> The ratio question has been debated within ABET ever since its founding in 1932. There is no clear answer The variables are so many that we can not pin-point a factual "ideal" or "acceptable" ratio. ABET considers 1:13 to 1:19 good ratios These numbers appear to be reasonable so that the instructor can get to know each student by name and as a person and also can obtain a good indication of intellectual capacity. We believe that a profession requires the tutor-mentor relationship and that larger ratios tend to obliterate it. The ideal ratio of 1:1 is not appropriate for engineering, as we operate as a team in the practice of the profession. Though we cannot prove it one way or the other -- good or bad -- we believe that ratios above 1:30 are not conducive to good interaction, especially in senior or graduate-level courses However, these and higher ratios would be permissible in courses which lend themselves to pedagogical methods that utilize different types of learning aids such as computers or demonstration equipment.
>
> The bottom line to ABET is whether or not the student has learned to the level necessary to enter the profession -- outcome. How the criteria is met is not ABET's responsibility Making the case for adequacy of the ratio is the institution's responsibility Thus, we do not prescribe ratios, we use them only as guides. They do seem to indicate that high ratios, 1:20 and above, seems to lower the quality of education

The engineering departments of the University of California operate with budgeted faculty-student ratios that are clearly within this rule-of-thumb measure The headcount ratios on State University campuses, however, lie in the range where they would have to demonstrate clearly to ABET accreditation teams that their faculty's essential non-classroom functions of student counseling and assistance, curriculum development, and institutional governance, are being met adequately.

FIVE

CONCLUSIONS AND COMMENTS

To summarize this report, this final chapter addresses one-by-one the four issues raised in Senate Resolution 37: (1) existing ratios of part-time to full-time faculty in engineering programs of the University of California and the California State University, (2) the minimum full-time staffing requirements as a function of student enrollments on each campus, (3) the relation of these ratios to standards of the Accreditation Board for Engineering and Technology, and (4) the budget requirements for the 1985-86 fiscal year needed to fund an appropriate full-time faculty at all University and State University schools of engineering.

1. EXISTING RATIOS OF PART-TIME TO FULL-TIME FACULTY

University of California: In 1983-84 the University employs a relatively high percentage of part-time faculty -- nearly 40 percent -- in its engineering programs, due largely to its non-competitive salaries during that and five of the six prior years and in spite of its special salary schedule for engineering and business that the Regents introduced in 1982.

The University is striving to fill 59.5 full-time engineering faculty positions, which would reduce its number of part-time faculty by approximately two-thirds while still reserving approximately 35.8 full-time positions to be filled by approximately 149 part-time faculty members who can bring specialized expertise to its programs As shown in Table 3 on page 5, filling these 59.5 positions would bring the percentage of part-time to total faculty in line with comparable doctorate granting universities. Engineering programs on the Los Angeles campus would continue to operate with a relatively high percentage of part-time faculty, but industrial resources in the Los Angeles basin are among the best in the nation to tap for special program needs.

The California State University. With nearly 50 pecent of its engineering faculty employed on a part-time basis and with over 20 percent of its instructional activities carried on by these part-time faculty members, the State University hopes to reduce these percentages by hiring additional full-time faculty. However, with the current impasse in collective bargaining, recruitment has been slowed Furthermore, the Office of the Chancellor reports that "some campuses . . . have been depending to a disturbing extent not so much on part-time faculty but rather on full-time temporary faculty who were not suitable tenure-track appointees For those campuses, adjustment of the part-time full-time faculty ratio would probably not be sufficient to solve their faculty problems."

As a result, Commission staff has estimated that the State University needs to recruit over 100 new qualified full-time faculty in order to ensure vitality to its engineering programs.* This would bring its percentage of part-time faculty down to the range of other comprehensive universities and to its salary comparison institutions while still providing for an adequate number of part-time appointments (estimated at 236) to provide specialized expertise on each campus.

2. MINIMUM FULL-TIME STAFFING REQUIREMENTS

The budgeted ratios of engineering faculty to students at campuses of the University range from 1:12 to 1:14, while headcount ratios at State University campuses range from 1.15 to 1:28 and full-time equivalent ratios range from 1·14 to 1:20. In view of the fact that most University students attend full time and a large portion of State University students attend part time, these ratios may be appropriate. However, there is reason to believe that teaching loads in engineering are too high on some State University campuses. Most qualified candidates for teaching positions in engineering on State University campuses have rejected these offers for two major reasons -- inadequate salaries, and high teaching loads. The relationship of these ratios to accreditation criteria are discussed below.

3. THE RELATION OF THESE RATIOS TO ACCREDITATION STANDARDS

At the present time, the Accreditation Board for Engineering and Technology (ABET) does not specify numerical ratios of part-time to full-time faculty, nor the number of full-time faculty, nor faculty-student ratios, as do many other professional accreditating agencies As noted in Chapter Four, however, ABET's Board of Directors may implement a standard calling for no fewer than three full-time equivalent faculty members for each program seeking accreditation, beginning in 1985-86. Consequently, in terms of numbers, all University and State University campus would meet this proposed criterion. However, ABET requires that "effective mechanisms are in place to assure adequate levels of student-faculty interaction, student advising, and faculty concern for and control over the curriculum." High part-time to full-time faculty ratios and high faculty-student ratios on some State University campuses may cause ABET visiting teams to question the effectiveness of their mechanisms and the adequacy of their levels of interaction, advising, and curriculum control.

*The 1983 American Electronics Association survey of engineering programs on the State University campuses found a combined need of 222 full-time tenure track faculty to replace part-time faculty and to fill authorized positions that were temporarily filled by full-time faculty because of the lack of success in recruiting tenure-track faculty. If these figures are correct, the State University accounts for 14 percent of the nation's engineering faculty vacancies. This survey also revealed that the course load carried by part-time and temporary faculty increased from 15 percent in 1975 to 44 percent in 1981 (Hubbard, 1983)

4 BUDGET REQUIREMENTS TO FUND APPROPRIATE FACULTY

The Governor and the Legislature responded positively to the segments' requests and the Commission's annual faculty salary report on the increases necessary in 1984-85 to reach projected parity with a set of comparison institutions. As a result, average faculty salaries in the University and State University were brought up to a point somewhat above the average salaries paid by their respective comparison institutions.

The University of California hopes to maintain its relative competitive position in 1985-86. As a matter of administrative priority, in 1981 it developed a special salary schedule for faculty in engineering and business administration. On the assumption that it will maintain its relative position with respect to its comparison institutions, the University will not need additional salary funds for engineering faculty beyond those to be requested for general faculty in 1985-86 in order to recruit and retain adequate numbers of qualified engineering faculty.

At the time this report was being prepared, the State University was uncertain about its own salaries for 1984-85 because an impasse had been declared in collective bargaining with the California Faculty Association. On December 14, however, the Board of Trustees and the Association approved a new contract that provided 10.5 percent pay increases, meritorious performance awards, and a special salary schedule for faculty in hard-to-hire disciplines, including computer science, engineering, and business. The special salary schedule, initiated through a $1.9 million appropriation contained in the Budget Act for 1984-85 specifically for this purpose, provides for salary differentials of 22 percent for assistant professors, 11 percent for associate professors, and 8 percent for professors. These differentials were derived from comparing engineering salaries at the State University with engineering salary levels in its comparison institutions. Table 14 shows the approximate salary lag for engineering faculty that existed in 1983-84. The Chancellor's Office of the State University believes the new scale is competitive. Funds to implement the new salary schedule on a limited basis are currently available within the 1984-85 budget No separate request for additional funds beyond those provided for in the Governor's 1985-86 Budget will be made during this budget cycle.

TABLE 14 1984-85 Faculty Salaries at the State University's Comparison Institutions That Offer Engineering and Projected at the State University, Assuming a 9 Percent Increase Over Its 1983-84 Salaries

Rank	Comparison Institutions	Projected State University	Difference
Professor	$ 44,040	$ 40,737	- 8 1%
Associate Professor	34,530	30,840	-12 9
Assistant Professor	31,180	25,688	-21 4

Source: Office of the Chancellor, The California State University.

Senate Resolution No. 37

Introduced by Senator Leroy Greene

Relative to postsecondary education

WHEREAS, An appropriate balance of full-time and part-time faculty is needed for both actual teaching responsibilities and support of the educational program to maintain the quality of engineering education, and

WHEREAS, Increasing the ratio of part-time to full-time faculty correspondingly increases the nonclassroom burdens, such as counseling, program development, and administrative functions among others, on full-time faculty, and

WHEREAS, Industrial support and part-time faculty are vital elements in the engineering educational programs, but there is a certain level of full-time faculty appropriate to administer the broad needs of the programs, now, therefore, be it

Resolved by the Senate of the State of California, That the California Postsecondary Education Commission is hereby requested to conduct a study, in conjunction with the University of California and the California State University, to identify the existing ratio of full-time and part-time faculty for undergraduate programs in University of California and California State University schools of engineering, and be it further

Resolved, That the study shall report the minimum full-time staffing requirements as a function of undergraduate student enrollment in the schools of engineering for each of the university campuses, compare existing ratios to the standards which are currently accepted by the appropriate professional accrediting bodies, and report the budget requirements needed to fund an appropriate full-time undergraduate faculty at all University of California and California State University schools of engineering, and be it further

Resolved, That the California Postsecondary Education Commission is requested to report to the Legislature on the results of the study within six months after the effective date of this resolution, and to make budget recommendations, based on prevailing academic salary levels, to the University of California and the California State University for the 1985–86 fiscal year, and be it further

Resolved, That the Secretary of the Senate transmit a copy of this resolution to the California Postsecondary Education Commission Senate Resolution No 37 read and adopted by the Senate June 13, 1984

Attest

Secretary of the Senate

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